Comments of Water Legacy on PolyMet Mining Inc. (PolyMet) Application for Clean Water Act Section 404 Permit for PolyMet NorthMet Mining Project December 14, 2015

Mercury

The treatment targets for the mine site wastewater treatment plant from year 1 to at least year 52 would not permit discharge of treated water to surface water. Based on current baseline hardness in the proposed West Pit Outlet Creek of less than 50 mg/L (FEIS, 4-91, Table 4.2.2- 15), the mine site wastewater treatment facility (WWTF) target for lead (10 µg/L) would be more than 7 times the chronic water quality standard (1.3 µg/L);[26] the WWTF target for nickel (113 µg/) would be nearly 4 times the water quality standard (29 µg/L);[27] and the WWTF target for sulfate would be 250 mg/L, 25 times the 10 mg/L standard applicable in wild rice waters.(*See* FEIS, 5-148, Table 5.2.2-2 for WWTF targets). The predicted mercury concentration in WWTF effluent would be 5.8 ng/L (PolyMet RS66, Mercury Mass Balance Attach. A, Exhibit 4 to WaterLegacy SDEIS Comments), nearly 5 times the Great Lakes Initiative water quality standard of 1.3 ng/L. This low-quality effluent could not be used to augment the aquifer to protect wetlands from water drawdown or to mitigate mine site seepage impacts. (pg. 26).

Mine Site Reverse Osmosis in Year 1 could return treated, clean water to mine site streams and surficial aquifer mitigating indirect impacts of wetlands drawdown. Reduction in the degree to which mine site wetlands were impacted by hydrologic change would have the potential to mitigate the degree to which mine site wetting and drying cycles enhance mercury methylation. In addition, if PolyMet's modeling of the volume, timing or solute concentrations of polluted seepage at the mine site has underestimated environmental effects, the Reverse Osmosis in Year 1 alternative would allow discharge of clean water to mitigate impacts while additional engineering solutions to prevent seepage are put into place. (pg. 27).

No supporting documents fully disclose the chemical constituents of the hydrometallurgical residue facility. However, the little information available confirms that the constituents of the HRF would pose serious risks to the aquatic ecosystem and to human health if they were ever to leak or spill. Co-Lead Agency responses to comments state that 164 pounds of mercury would be deposited in the hydrometallurgical facility each year. (FEIS, A-414). Over a 20-year mine life, up to 3,280 pounds of mercury could be deposited in the HRF. (pg. 28).

Although the degree to which leakage and seepage of concentrated and toxic chemicals would adversely affect aquatic ecosystems is difficult to quantify given the lack of information in the FEIS, there is a clear environmental benefit to locating the hydrometallurgical residue facility on a site with a level, stable and dry foundation, where predictions of infrequent leakage are much more likely to be realized. More effectively containing mercury, arsenic, manganese, cobalt, copper, lead and sulfate so that they are not released to surface water and groundwater would reduce impacts on the aquatic ecosystem and human use characteristics, pursuant to Subparts C and F of Chapter 40, Part 230 in these rules. (pg. 30).

Environmental benefits of the dry stack tailings alternative include reducing secondary impacts on wetlands and wetlands water quality functions resulting from sulfate air deposition, sulfate and mercury seepage, and hydrological changes due to seepage capture. The FEIS identified 4068.3 acres of wetlands within plant site flowpaths (FEIS, 5-333, Table 5.2.3-10), but did not determine secondary effects on any of these wetlands or discuss any of the ways in which the proposed NorthMet tailings storage facility would affect production and export of methylmercury. (pg. 32).

`The Mine Site Reverse Osmosis in Year 1 alternative was proposed to provide a method of mitigating drawdown of high quality mine site wetlands as a result of mine dewatering. Had the FEIS determined secondary effects on wetlands hydrology from mine dewatering, including potential effects on methylmercury production and export, analysis of this potential LEDPA would have been prioritized. (pg. 33).

Both Minnesota water quality standards and downstream water quality standards of the Fond du Lac Band, adopted pursuant to Section 518 of the Clean Water Act, 33 U.S.C. §1377, contain numeric water quality standards limiting the concentration of mercury in the water column. Minnesota's water column mercury limit in Lake Superior Basin waters, pursuant to the federal Great Lakes Initiative, is 1.3 nanograms per liter (ng/L). Minn. R.7052.0100, subp. 2. The Fond du Lac Band has set a mercury water column standard of 0.77 nanograms to protect Tribe members who have a higher daily human consumption of fish (0.060 kilograms per day) than that assumed in the Great Lakes Initiative methodology used to develop of water quality standards. Fond du Lac Water Quality Standards, Ord. #12/98 as amended, Sect. 301e.1; Appx. 1, Standards Specific to Designated Use. (pg. 53)

Methylmercury is the form of mercury that bioaccumulates in the food chain, including edible fish tissue. Minnesota has a standard for mercury that bioaccumulates in edible fish tissue, applicable across the range of waters used for fishing and drinking water, of 0.2 micrograms per kilogram (µg/kg). Minn. R. 7050.0220, subp. 3a, 4a, 5a. This standard is based on the EPA's methylmercury criterion for fish tissue to protect human health and the particular pattern of fish consumption in Minnesota. Because of the higher fish consumption rate in the state, Minnesota has a lower fish tissue mercury criterion than the EPA's rate of 0.3 mg/kg.[37] Findings that Minnesota water bodies are impaired due to mercury in fish tissue are based on application of the 0.2 µg/kg health-based standard. (pg.54).

Explicitly challenging the assumption that impacts of the NorthMet project on mercury and methylmercury would not affect the St. Louis River, Dr. Branfireun detailed the process by which methylmercury is exported to surface waters and transported downstream. (*Id.*, pp. 26-27). Methylmercury from wetlands near the NorthMet site would be exported to tributaries of the Partridge and Embarrass Rivers by baseflow in a continuous supply to streams and by flow during snowmelt and rainstorms. Much of the methylmercury derived from wetlands would be bound to dissolved organic matter derived from the decomposition of wetland soils, so the methylmercury would remain stable, even under oxygenated stream conditions and would have lower demethylation rates from light. (pg. 59)

The Embarrass River chain of lakes downstream of the proposed NorthMet tailings site - Sabin, Wynne, and Embarrass Lakes -- are impaired due to excessive mercury in fish tissue. Colby Lake, into which the Partridge River flows downstream of the proposed mine site, is also impaired due to excessive mercury in fish tissue. (FEIS, 4-29, Table 4.2.2-2). Based on the sampling done for the NorthMet project, the Partridge River and Embarrass River may also be impaired for aquatic consumption due to excessive mercury. Mean concentrations of mercury at surface water sites in the Partridge River (2.3 to 5.4 ng/L) and mean concentrations in the Embarrass River (4.3 to 5.1 ng/L) are two to four times higher than Minnesota's water column standard of 1.3 ng/L. (FEIS, 4-41, Table 4.2.2-4). (pg. 61)

The FEIS asserts with incomprehensible precision that mercury loading in the Partridge River would decrease from 24.2 to 23 grams per year as a result of the PolyMet NorthMet mine project, more offsetting the 0.2 gram increase (from 22.3 to 22.5 grams per year) in mercury loading to the Embarrass River. (FEIS, ES-36, 5-462).

However, the FEIS failed to provide basic data regarding mercury loading. The FEIS does not disclose its assumptions as to the mass or concentration of mercury in potential project sources of contamination, including peat, overburden, ore, waste rock, process water, tailings, reject concentrate, filtered sludge, hydrometallurgical residue or coal ash, or any other potential sources of mercury release from the project. Responses to comments state that estimates for major mercury sources was based on studies done for PolyMet in 2004 and 2005 (FEIS, A-414), but these studies are not included in the FEIS reference documents and neither their methodologies nor numeric values are disclosed. Thus, the FEIS does not permit any verification that mercury projections prepared by PolyMet and adopted by the FEIS (FEIS, 5-226, Table 5.2.2-49, PolyMet 2015m) are consistent with good scientific practice and local geology. (pg. 65).

Despite the minute scale of differences in mercury loading claimed in the FEIS, the FEIS failed to analyze mercury air deposition, much of which would be locally deposited, as a potential source of mass loading to either the Partridge or Embarrass River. The FEIS states, "Mercury air emissions and subsequent mercury deposition were not assessed for the Mine Site because potential emissions are less than 1.0 lb/yr." (FEIS, p. 5-462). Although 1.0 pound per year may not be significant for Minnesota's statewide mercury TMDL, it is equivalent to 453.6 grams per year. This is an astronomical number when compared to the FEIS' mercury loading calculations. If far less than one percent of NorthMet mine site mercury deposition found its way into the Partridge River, the net effect of the NorthMet project, with no other revisions or corrections, would increase mercury loading to the St. Louis River. (pg 66).

Similarly, the FEIS failed to quantify mass loading to the Embarrass River from the 4.6 pounds of mercury that will be emitted each year from the plant site. The underlying referencefor the FEIS analysis states that under the more conservative assumption that only 25% of mercury from the plant is elemental, up to 3.68 pounds or 1,669.2 grams of NorthMet plant site mercury emissions may be deposited locally each year, within a 10-kilometer radius of the plant site. (PolyMet 2015e, Appendix C to Attachment U, p. 2, autop. 1091). Yet, as with the mine site mercury deposition, the FEIS does not evaluate the effects if even a small portion of the potentially 1,669.2 grams of mercury locally deposited were included in the mercury loading to the Embarrass River. (pg. 66).

The FEIS narrative does not state how seepage through LTVSMC tailings affects mercury concentrations, but the data are clear. Mercury in the existing Cell 2E pond has a mean concentration of 1.4 ng/L. Mercury in the toe of the existing tailings facility has a mean concentration of 4.9 ng/L. (FEIS, 4-126, Table 4.2.2-23). Using simple arithmetic, the FEIS has shown that in passing through the existing LTVSMC tailings mean mercury *more than triples*. (pg. 66)

Colby Lake water mercury concentrations substantially exceed the Great Lakes Initiative and Minnesota water quality standard of 1.3 ng/L. FEIS data indicates mercury concentrations in Colby Lake are between 4.6 and 8.7 ng/L, averaging 6.0 ng/L. (FEIS, 4-37 to 4-38). During operations, maximum plant site water appropriation of water from Colby Lake would be 15.1 million gallons per day (MGD) or 1,300 million gallons per year (MGY). (FEIS, 5-201, Table 5.2.2-40). This maximum is equivalent to 10,486 gallons per minute (gpm) from Colby Lake, which is *more than four times* the 2,425 gpm total combined stream flow to the WWTP predicted in the FEIS. (FEIS, 5-230, Table 5.2.2-51). Yet, despite the substantial volume and concentration of mercury in Colby Lake waters, the FEIS neither changes its claim that the concentration of mercury in inputs to the WWTP will be 1.3 ng/L nor justifies this assumption. (pg. 69)

The FEIS' mechanistic construct for mercury loading is scientifically indefensible and unsupported by review of the potential sources of mercury loading resulting from the PolyMet NorthMet project. The FEIS relies on unsubstantiated assumptions of seepage collection to minimize likely adverse effects of sulfate loading on wetlands and uses a model that explicitly denies the potential discharge to wetlands, the sites where most methylation of mercury is likely to occur. The FEIS disaggregates and minimizes sulfate loading through deposition and spillage. Although assurance is provided that reverse osmosis will result in compliance with all water quality standards, including the mercury standard, treatment plant inflow assumptions are contrived to require no treatment and there is neither a pilot test nor plan for mercury removal from wastewater. Finally, despite the clear significance of methylmercury production and transport to downstream water quality, aquatic life and human health, the FEIS has avoided any analysis of the impacts of mercury discharge, sulfate loading or hydrologic changes from the NorthMet project on increased production and transport of methylmercury. (pg. 70).

The FEIS is not only inadequate under NEPA, but inadequate to demonstrate that mercury and methylmercury increases will not significantly degrade downstream waters, increase exceedances of both water column and fish tissue mercury, and increase violation of both narrative and numeric water quality standards. On the basis of this issue alone, no Section 404 permit can be issued. (pg. 70)

Methylmercury

In addition to prohibiting significant degradation or the violation of applicable water quality standards, Section 404 regulations specify the findings needed to determine compliance or non-compliance with regulatory Guidelines. Pertinent to the discussion of mercury and methylmercury, permits must be specified as failing to comply with Section 404 requirements, either if the proposed discharge "will result in significant degradation of the aquatic ecosystem under §230.10(b) or (c)" or if there "does not exist sufficient information to make a reasonable judgment as to whether the proposed discharge will comply with these Guidelines." 40 C.F.R §230.12(a)(3)(ii), (iv). (pg. 54).

Methylmercury would be transported in the Partridge and Embarrass Rivers dissolved in water, sorbed to particles, bound to plant matter and algae, and bioaccumulated into aquatic organisms including fish. Methylmercury dissolved in water and in suspended inorganic and organic particles, as well as biological media, would flow into the St. Louis River as well as continuing to cycle through sorption and the aquatic food chain. Although there are numerous lakes, reservoirs and other sources and sinks for methylmercury in the 12-15 miles from NorthMet site features to the St. Louis River, Dr. Branfireun explained that there is no physical or chemical basis to discount contributions of methylmercury from tributaries of the Partridge and Embarrass Rivers to the St. Louis River. In addition, there are no barriers to fish movement, so entry of methylmercury into higher organisms and fish could occur upstream in the Partridge and Embarrass Rivers and the fish could migrate downstream to the St. Louis River. (pg. 59).

In terms of methylmercury, exposure is largely due to ingestion of fish with high mercury content. Methylmercury builds in the food chain. When pregnant women eat fish high in methylmercury, the fetus is then exposed to this lipophilic heavy metal. The placenta is not protective and the blood brain barrier is not well formed until after age two years, which makes fetuses, infants and young children most vulnerable to methylmercury's neurotoxic effects. Neurons in the developing brain multiply at a rapid rate and are particularly vulnerable to toxic effects of heavy metals, hence brain damage is more likely to occur during this vulnerable time. Neurotoxicity is also transferred to the infant through breast milk. (pg. 60).

The FEIS uses several constructs to deny the adverse effects of mercury and methylmercury on downstream waters. First, the FEIS adopts a mechanistic model that it characterizes as a "mass balance" model to claim that any increases of mercury in the Embarrass River from mercury loading would be offset by corresponding decreases in mercury loading in the Partridge River. Next, the FEIS misrepresents the well-accepted peer-reviewed science in an effort to deny the potential for increased methylmercury production and transport. Finally, the FEIS omits, distorts and in some cases misrepresents information needed to evaluate the effects of the PolyMet NorthMet proposed action. (pg. 62)

Sulfate/Sulfide

PolyMet tailings seepage would be collected from the toe of the tailings heaps and would contain sulfates and heavy metals from copper-nickel processing slurry, effluent from the mine site treatment plant, and LTVSMC tailings. (FEIS ref. PolyMet 2015j, FEIS Figure 3.2-12). Solutes in the seepage, including arsenic, mercury, manganese, and lead are known to impair human health; sulfate is known to be toxic to wild rice and to enhance mercury methylation; and metals and salts including copper, nickel, cobalt, lead, mercury, and specific conductance are known to adversely impact aquatic life. (pg. 10)

In addition to environmental damage due to uncaptured seepage and the reasonably foreseeable environmental damage from catastrophic dam failure, the proposed use of the LTVSMC site for NorthMet tailings disposal would have substantial direct and indirect impacts on wetlands. The Proposed Action would result in direct destruction of 148.4 acres of wetlands (FEIS, 5-322, Table 5.2.3-8) and potentially impact thousands of additional acres of wetlands as the result of dewatering resulting from seepage collection, sulfate deposition and seepage mpacts on water quality. (*See* FEIS, 5-333, Table 5.2.3-10; 5-345, Table 5.2.3-12). (pg. 21)

The February 2007 PolyMet RS33/RS65 Hydrometallurgical Residue Characterization (provided as Exhibit 27 to WaterLegacy SDEIS comments although not included among FEIS references) indicated that tested hydrometallurgical leachate residue would have sulfate levels of 7,347 mg/L. Although we have found no document in the EIS record that provides contaminant levels for filtered sludge, before WWTP reject concentrate is dewatered it would contain levels of arsenic and metals as much three orders of magnitude above applicable limits. At the P90 level, reject concentrate would contain: 1,150 µg/L of arsenic (2 µg/L criterion for drinking water); 16,600 µg/L of manganese (100 µg/L HRL for drinking water); 847 of cobalt (5 µg/L surface water limit); 11,600 µg/L of copper (9.3 µg/L limit in water with 100 mg/L hardness); 1,290 µg/L of lead (3.2 µg/L limit in water with 100 mg/L hardness); 8,230 mg/L of sulfate (10 mg/L limit in wild rice waters). (FEIS ref. PolyMet 2015m, autop. 452). (pg. 29)

The FEIS acknowledges that the proposed sulfide mine project could indirectly affect up to 7,694.2 acres of wetlands located within and around project sites (FEIS, 5-251), a total of 8,608 acres combining direct and indirect project wetlands. When compared with *existing* wetlands, the potential impacts of the PolyMet NorthMet project on wetlands in the Partridge and Embarrass River watersheds could affect up to 13 percent of the 65,567 remaining acres of wetlands in the two watersheds combined. (FEIS, 6-57, Table 6.2.3-3). (pg. 51)

Thus, the data confirms that both the proposed NorthMet mine site and tailings site are highly methylating environments and that the methylation that takes place in wetlands in these watersheds is exported to surface waters. Mine site ombrotrophic bogs are not wetlands with a "low likelihood" of impacts from mine dewatering where the critical function of water quality is concerned. They must be considered wetlands with a "very high likelihood" of indirect effects on mercury methylation, whether or not there is a detectable change in plant communities. Finally, based on the sensitivity of the surrounding aquatic ecosystem to impacts of sulfate and hydrologic impacts, the NorthMet mine site and tailings site locations seem particularly ill-suited for a copper-nickel sulfide mine and tailings storage facility. (pg. 56)

As discussed in more detail in WaterLegacy's comments on the FEIS and in Section I *supra*, FEIS claims regarding sulfate loading to proximate wetlands and streams are based on unsubstantiated assumptions regarding collection of seepage at the tailings waste storage facility and the Category 1 waste rock pile as well as uncertain and unreliable hydrologic modeling at the mine site. In addition, the FEIS' claims that the NorthMet project will reduce sulfate loading to the Embarrass River are based on an inappropriate "continuation of existing conditions" baseline that neither includes natural attenuation of contaminants nor legally-required improvements resulting from the Cliffs Erie Consent decree and compliance with Minnesota water quality standards. (FEIS, ES-49, 5-94). (pg. 67)

As discussed in Section II, *supra*, the FEIS provided no data regarding sulfate loading to wetlands from mine site leakage or seepage, since PolyMet's model assumed that all leakage/seepage released directly to the Partridge River. (FEIS, 5-320, citing PolyMet 2015m). Sulfate seepage impacts on methylation at NorthMet mine site wetlands could be significant. At the mine site, even as compared to continuation of existing conditions scenario, P90 sulfate is predicted to more than triple along the overburden storage and laydown flowpath and along the West Pit flowpath. (FEIS, 5-129, Table 5.2.2-23). There are 516 acres of wetlands within mine site surficial aquifer flowpaths. (FEIS, 5-320; Table 5.2.3-7). (pg. 68)

Conductivity

These assumptions are not based on assessment of hydrogeology and run counter to expert opinions from geologists. The FEIS cross-section of the tailings basin groundwater containment system characterizes the bedrock as an "assumed no flow boundary." (FEIS, Figure 3.2-28). The FEIS also uses mine site Duluth Complex bedrock as an analogy to assume very low hydraulic conductivity at bedrock depths beneath the tailings piles. (FEIS, 4-44). Although the FEIS estimates flow through the top 20 feet of bedrock at 0.14 feet per day (FEIS, 4-113), neither the FEIS nor the

PolyMet reports on which it is based dig any deeper. Beneath the top 20 feet, neither the FEIS nor underlying documents provide any information of any kind in the record on the hydraulic conductivity of tailings site bedrock. (See FEIS ref. Barr 2014b, pp. 21- 22, Large Figures 1-2). The FEIS also provides *no* investigation of fractures beneath the tailings waste site. (pg. 11)

Mr. Lehr also criticized the PolyMet NorthMet SDEIS for failing to include any hydraulic testing of bedrock in the tailings site area. (*Id.*, p. 12, p. 15). He explained that analogies between Duluth Complex at the mine site and Giants Range Granite at the tailings site cannot be used to assume hydraulic conductivity of bedrock at the tailings site, since Giants Range Granite is 1,600 million years older than Duluth Complex and "would have experienced a different stress, weathering and erosional history than the Duluth Complex." (*Id.*, p. 15).

Mr. Lehr emphasized that, to assess hydraulic conductivity, "What the SDEIS requires is data." (*Id.*, pp. 15-16) "Unless a solid scientific basis is provided, the SDEIS' claims – both explicit and implicit – that groundwater flow through bedrock is minimal, cannot be sustained." (*Id.*, p. 16). Based on the scientific literature and his professional knowledge of the region's geology, J.D. Lehr concluded, "bedrock fractures will play a significant role in groundwater and contaminant transport" at the tailings site. (*Id.*, p. 17). (pg. 12)

Reference documents undermine these claims for seepage collection. Although the FEIS refers to the containment to be installed to collect seepage as a "low-permeability cut-off wall keyed into bedrock" (FEIS, 5-7), the actual design provides for the use of "compacted soil" as a barrier around the waste rock pile. (FEIS ref. PolyMet 2015h, p. 10). Specifications for the hydraulic conductivity are 1×10^{-5} centimeters per second (*Id.*, p. 13), which is generally classified as "semi-permeable" soil. (pg. 23)

The FEIS' predictions of minimal Category 1 seepage flow were also based on an assumption that the cover placed on the rock pile would reduce infiltration by more than 99 percent (from 360 gpm to 2.8 gpm). (FEIS, 5-145). PolyMet's document from which this conclusion is drawn admits that geomembranes have not been used for many waste rock stockpile covers and that use is generally limited to projects with an average size of less than 30 acres. (PolyMet 2015d, p. 45). Yet, PolyMet (2015d) and the FEIS calculate infiltration solely on the basis of liner defects per acre of liners, without considering the topography of massive waste rock piles. PolyMet identifies three mine sites where geomembranes have been used as a cover, but does not describe seepage results. One of these featured sites is the Dunka Mine (*Id.*, p. 46). Unsurprisingly, the FEIS does not cite the Dunka Mine in its predictions that infiltration and seepage will be prevented. Despite its geomembrane, Dunka Mine waste rock seepage has resulted and continues to result in ongoing violations of Minnesota water quality standards for copper, nickel, hardness and specific conductivity. (See Dunka Mine DMR summaries, provided in Exhibit 34). (pg. 24)

Indirect impacts on mine site wetlands as a result of mine dewatering are likely to be quite severe. As noted above, mine dewatering could adversely affect 5,720 acres of proximate wetlands. (FEIS, App. C, autop. 2994). PolyMet has recently re-evaluated the hydraulic conductivity of both wetlands and rock formations at the mine site. Although conductivity of Duluth Complex rock was unchanged in this analysis, the conductivity of both wetlands deposits (horizontal conductivity) and Virginia Formation bedrock (both horizontal and vertical conductivity) was calculated at *400 percent* of the conductivity modeled in the 2013 SDEIS. (Comparison is based on SDEIS, 5-27, Table 5.2.2-7 and FEIS, 5-29 Table 5.2.2-7). As a result, peak inflows and dewatering of the Partridge River watershed could be as much as 760 gallons per minute (FEIS, 5-111, Table 5.5.2-19) or 399,700,000 gallons per year removed from mine site groundwater. (pg. 27)

MODFLOW has recently been used to update predictions highly relevant to the assessment of the nature and cone of depression. As described in more detail in WaterLegacy's comments on the FEIS, PolyMet recently updated its assessment of the hydraulic conductivity of wetland deposits and of Virginia Formation bedrock (FEIS, 5-19. 5-29, Table 5.2.2-7) and revised its estimates of groundwater inflow to the west and east mine pits. (FEIS, 5-111, Table 5.2.2-19). The Co-lead Agencies also recently used MODFLOW to predict the number of inches of downward leakage through wetlands necessary to prevent northward flow as a result of the downhill hydraulic gradient of the Northshore Mine Peter Mitchell Pit. (FEIS, 6-41, MDNR et al 2015c). There is every indication that MODFLOW is a robust, practicable and readily available model for analysis of conductivity, hydrology and flow through mine pits, bedrock, and surficial materials at the NorthMet mine site, the parameters most relevant to determine secondary wetlands drawdown impacts. (pg. 35)

Particular concerns are raised regarding specific conductance, a combination of ionic pollutants that are a signature mining pollutant known to persist downstream for many miles in the St. Louis River watershed. Specific conductivity increases, among other mining pollutants, would have the potential to violate narrative water quality standards of the Fond du Lac Band applicable in St. Louis River Reservation waters. Fond du Lac Water Quality Standards, Ord. #12/98 as amended, Sect. 105a.1; Sect. 301e. (pg. 71)

The FEIS also failed to analyze specific conductivity, a signature mining pollutant that has resulted in impairments of fish and macroinvertebrates in Northern Minnesota waters. (see Section VII of WaterLegacy's comments on the FEIS). Specific conductivity ionic pollution is likely to degrade aquatic life for fish and invertebrates in surface water downstream of the NorthMet project. (pg. 78)

Dry Stacking

The FEIS states that the *Independent Report* on Mount Polley was after the SDEIS comment period ended and Co-Lead Agency technical analysis confirmed, "use of dry stacking technology would increase tailings basin stability." Further evaluation of this alternative was rejected, however, on the grounds that use of dry stacking requires a basin liner, which is not feasible on top of the existing LTVSMC tailings basin. Use of a different location and a lined dry stack facility was then rejected on the grounds, "A separate dry stack tailings basin would increase footprint effects of the project" and that "A separate dry stack tailings basin would not address LTVSMC tailings basin legacy issues." (FEIS, A-315) (pg. 21)

Comments of Water Legacy on
PolyMet NorthMet Mining Project and Land Exchange
Final Environmental Impact Statement
December 14, 2015

Mercury

The only change made in the PolyMet NorthMet project in response to WaterLegacy's comments regarding mercury is that the project no longer proposes to use untreated high-mercury Colby Lake water for stream augmentation in the wetlands complex north of the tailings waste facility, identified in the SDEIS as a high-risk location for mercury methylation. The FEIS states that Colby Lake water will be treated at the tailings site wastewater treatment plant (WWTP) prior to use for stream augmentation (FEIS, 2-10). However, the benefit of this change is uncertain, since the FEIS fails to analyze how mercury inputs from Colby Lake water transfer would affect tailings pond, tailings seepage and the WWTP. These impacts are likely to be significant. (pg. 6)

Despite the high concentration of mercury in Colby Lake water and the volume of Colby Lake water that would be piped to the plant site, the FEIS' estimate of mercury in the inflows to the WWTP (FEIS, 5-230, Table 5.2.2-51) does not consider mercury inputs from Colby Lake water. Comparing the FEIS Table for Estimated Mercury Concentration of the Combined Inflows to the Plant Site WWTP to the same Table in the SDEIS (SDEIS, 5-206, Table 5.2.2-52), no adjustment has been made for an increased mercury concentration resulting from the need to treat Colby Lake water. The FEIS' prediction that the combined inflows to the WWTP will have a mercury concentration of precisely 1.3 ng/L, the GLI water quality standard, is unchanged. (pg. 7)

The PolyMet pilot test was conducted on water drawn from a seep and an aquifer well at the existing LTVSMC taconite tailings waste facility (Barr 2013f, p. 11). Mercury was below detectible levels in the *influent* for the test (*Id.*, autop. 64-69, Table 1, Table 2). The only conclusions regarding mercury in Barr report were based on literature and an inquiry to the membrane supplier. Barr reported, "Mercury removal by RO membranes is highly dependent on the type of membrane used. Mercury rejections [the percentage removed by treatment] ranging from 22 to 99.9% have been reported," (*Id.*, p. 39). The report continued, "Mercury removal by RO is highly variable and dependent upon its speciation and the membrane selection. For these reasons, its removal is difficult to quantify," (*Id.*, p. 41). Should mercury influent to the WWTP exceed 1.3 ng/L, the FEIS does not provide any basis to conclude that water quality treatment will result in compliance with the 1.3 ng/L GLI and Minnesota water quality standard for mercury. (pg. 8)

The FEIS asserts with incomprehensible precision that mercury loading in the Partridge River would *decrease* from 24.2 to 23 grams per year as a result of the PolyMet NorthMet mine project, more offsetting the 0.2 gram increase (from 22.3 to 22.5 grams per year) in mercury loading to the Embarrass River (FEIS, ES-36, 5-462). The FEIS has neither recognized nor responded to concerns about inadequate analysis of mercury air deposition and mercury seepage to substantiate this central claim. (pg. 8)

The FEIS still states, "Mercury air emissions and subsequent mercury deposition were not assessed for the Mine Site because potential emissions are less than 1.0 lb/yr," (FEIS, p. 5- 462). The FEIS does not acknowledge that 1.0 pound per year is equivalent to 453.6 grams per year. This is an astronomical number when compared to the FEIS' mercury loading offset calculations. If far less than one percent of NorthMet mine site mercury deposition found its way into the Partridge River, the net effect of the NorthMet project, with no other revisions or corrections, would increase mercury loading to the St. Louis River. (pg. 8)

Methylmercury

The FEIS also failed to resolve the deficiencies raised in WaterLegacy's prior comments. In several instances, the FEIS added new language to justify its prior conclusions without providing any new substantive analysis. Gaps, inconsistencies and misrepresentations of research data identified in WaterLegacy's comment on the SDEIS were not addressed. The FEIS continued to omit or mischaracterize data and research, thus minimizing or denying the impact of mercury and methylmercury on aquatic life, wildlife dependent on aquatic resources, human health and environmental justice. (pg. 6)

These statements contradict the purpose of an EIS and basic scientific integrity. It is beyond dispute that methylmercury is exported to streams as they pass through wetlands and that precipitation events and seasonal wetting cycles release methylmercury from peatlands into streams where that methylmercury can be incorporated into food chains. In fact, these points are both made in a recent Report of the Minnesota Department of Natural Resources (MDNR), one of the Co-Lead agencies preparing the FEIS. (pg. 16)

Despite statements of concern regarding methylmercury by the U. S. Environmental Protection Agency (EPA) and Tribal Cooperating Agencies,[12] as well as by WaterLegacy and medical organizations (see Exhibit 18, attached), the FEIS still makes no effort to analyze potential methylmercury effects from the NorthMet project. As Dr. Branfireun's expert opinions explain, the NorthMet mine, processing plant, waste facilities and ponds create conditions that increase production of methylmercury, including discharge and deposition of mercury, discharge and deposition of sulfate, and drying and rewetting of wetlands at both the mine site and tailings site. The FEIS fails to model mercury dynamics and claims that current scientific understanding of the factors affecting mercury methylation is too limited to perform an analysis (FEIS, 5-223). (pg. 16)

The FEIS analyzes only NorthMet plant mercury air emissions to model changes in fish methylmercury concentration. Without qualifying its conclusions to explain the limited analysis done, the FEIS goes yet farther than any prior EIS document to broadly dismiss methylmercury human health concerns on the basis of the small increases in this limited analysis; "Given that evidence and finding, no potential change in human health risks related to the fish consumption pathway is expected," (FEIS, 7-16). The simultaneous failure to analyze methylmercury production in the FEIS and its categorical denial of methylmercury effects is unacceptable under either NEPA or MEPA environmental assessment laws.3). (pg. 17)

The FEIS has used scientifically indefensible methods to minimize mercury impacts and avoid analysis of methylmercury impacts and has, thus, failed entirely to assess a highly significant risk to aquatic life, human health, tribal resources and impacts to Indian trust lands. The FEIS has provided no evaluation of the risks of northward flow of pollutants through the 100 Mile Swamp and to the Rainy River watershed and no evaluation of the indirect impacts of mine site and tailings site dewatering and pollution on wetlands, thousands of acres of which are in the 100 Mile Swamp and the Upper Partridge River, federal lands of high biological diversity. The FEIS has failed to analyze impacts of dam failure or failure of seepage collection and has used unsupported assumptions to avoid consideration of the transport of sulfate, mercury and methylmercury downstream to the St. Louis River and to reservation waters. Perhaps most troubling in terms of the substantive requirements for a land exchange, the FEIS has failed to analyze cumulative impacts on Indian trust lands and rights retained by Indian tribes in ceded territories. (pg. 59)

The FEIS has not rectified the deficiencies previously raised by WaterLegacy regarding impacts on aquatic life resulting from polluted seepage and discharge. As discussed in previous Sections I, II and III of these comments on the FEIS, deficiencies in sampling and modeling contaminant sources, unsubstantiated assumptions regarding collection of polluted seepage, assessment of water quality using misleading "evaluation criteria" and discharge evaluation locations, and failure to scientifically assess mercury releases and increased production and transport of methylmercury result in the inadequacy of the FEIS to assess impacts on aquatic life. (pg. 60)

As Margaret Saracino, M.D., a Duluth child adolescent psychiatrist, summarized in her opinion attached with these comments: In terms of methylmercury, exposure is largely due to ingestion of fish with high mercury content. Methylmercury builds in the food chain. When pregnant women eat fish high in methylmercury, the fetus is then exposed to this lipophilic heavy metal. The placenta is not protective and the blood brain barrier is not well formed until after age two years, which makes fetuses, infants and young children most vulnerable to methylmercury's neurotoxic effects. Neurons in the developing brain multiply at a rapid rate and are particularly vulnerable to toxic effects of heavy metals, hence brain damage is more likely to occur during this vulnerable time. Neurotoxicity is also transferred to the infant through breast milk. (pg. 66)

Dr. Saracino explained that neurodevelopmental disorders can be managed, but not cured. (*Id.*, p. 1). In addition to the suffering of exposed individuals and their families, neurodevelopmental disorders resulting from increased methylmercury and lead exposure can result in significant costs to families and communities as a result of needs for occupational therapy, physical therapy, speech and language therapy, special education service, outpatient and in-patient treatment and as a result of reduction in earning capacity. (*Id.*, pp. 2-3). The FEIS neither recognized nor assessed any of these costs. (pg. 66)

The PolyMet NorthMet FEIS' analysis of health risks suffers from the same inadequacies discussed in other sections of these comments. Unsupportable models and unsubstantiated assumptions affect assessment of impacts of surface water and groundwater pollution on human health. The failure to apply Health Risk Limits and Risk Assessment Advice to groundwater further biased FEIS conclusions. The FEIS denial of methylmercury increases and other adverse impacts, results in a failure to evaluate potentially serious threats to human health, particularly to children's health. It is rare for Minnesota's rather conservative medical community to be united in their concern. It is not too late to require an independent and rigorous assessment of the adverse health impacts of the PolyMet NorthMet sulfide mine project. (pg. 68)

In addition to a 1.3 ng/L standard for mercury in the water column discussed previously, Minnesota has a standard limiting mercury in edible fish tissue to protect human health, which is applicable across the range of waters used for fishing and drinking water, of 0.2 micrograms per kilogram (µg/kg). Minn. R. 7050.0220, subp. 3a, 4a, 5a. This standard is lower than the EPA's methylmercury criterion for fish tissue (0.3 mg/kg) because of the high rate of fish consumption in Minnesota. (pg. 96)

Sulfate/Sulfide

The FEIS states that the NorthMet project would reduce sulfate loading by more than 40 percent in the Embarrass River at PM-13. (FEIS, 6-48), relying on an unsubstantiated nearly perfect tailings seepage collection rate of 99.5 percent. The FEIS did not estimate sulfate reduction achievable through natural attenuation and seepage collection by Cliffs Erie at the existing LTVSMC as a result of regulatory controls. Failing to do so biased the analysis of the NorthMet project's impact on increased sulfate discharge and the resulting potential for mercury methylation. (pg. 12)

The FEIS provides more data on the various types of sulfur-containing air emissions, spillage and dust from the NorthMet mine site and plant site and more text explaining the potential relationship between sulfate deposition and mercury methylation than did the SDEIS. However, rather than using this data to provide a critical analysis of the aggregate impacts of these various forms of sulfate in methylating environments –

namely the wetlands closest to the deposition sources - the FEIS obscures and negates the potential impacts of local sulfur inputs on mercury methylation. (pg. 13)

Finally, the FEIS discusses sulfur in particulate matter that would be emitted from the plant site. Again, focusing on Colby Lake and Sabin Lake, but without disclosing the tons per year emitted, the FEIS predicts that deposition of sulfate in particulate matter would be 4 percent of background, once more deemed a small percentage of background. (FEIS, 5-510 to 5-511). However, here the FEIS provides an important additional analysis. Based on the assumption that all sulfur in fugitive dust converts to sulfate and mixes with surface water in wetlands. Assuming that all sulfur in fugitive dust converts to sulfate and mixes with surface water in wetlands, the FEIS predicts a *potential increase in wetlands sulfate concentrations of 4.2 mg/L*. (FEIS, 5-339) (pg. 14)

The FEIS admits, "small sulfate increases in sulfate-poor wetlands would be expected to increase the production of methylmercury in wetlands," (FEIS, 5-164). But the FEIS fails to explain that the three Upper Partridge tributary streams that drain relatively undisturbed watersheds --Wetlegs Creek, proposed West Pit Outlet Creek and Longnose Creek (FEIS, 4-83) -- reflect drainage from low-sulfate wetlands. Even according to the revised data in the FEIS, sulfate concentrations are 3.9 mg/L for Wetlegs Creek, 2.6 mg/L for proposed West Pit Outlet Creek and 0.91 mg/L for Longnose Creek (FEIS, 4-84).[9] Increased wetlands concentrations from fugitive dust alone, without considering ore spillage or sulfur-compound air deposition would more than double sulfate in all three undisturbed mine site creek watersheds and more than quadruple sulfate in the Longnose Creek watershed. It is undeniable, based solely on FEIS data, that mine site sulfate deposition would be expected to increase the production of methylmercury in mine site wetlands. (pg. 14)

The "contingency mitigation" proposal for northward flow of NorthMet contaminants into the Boundary Waters watershed exemplifies the risks of this approach. Again, the FEIS proposes that grouting might be used to prevent northward flow even though "its effectiveness at the NorthMet site is uncertain." (FEIS, 5-240). The next option on the list is lowering the water level in the East Pit and West Pit below the level (1,500 feet AMSL) of the Northshore Peter Mitchell Pit. (FEIS, 5-241). The FEIS notes that this option would "require a higher capacity water treatment facility and possibly additional treatment processes entailing additional expense." (*Id.*) The FEIS does not mention that the East Pit and West Pit are both permanent sources of contamination or the fact that the GoldSim model upon which the FEIS relied to assume that oxidation would be minimal in the East Pit was based on a Geochemical Uncertainty Analysis stating that exposure of East Pit walls to air would increase sulfate levels by a factor of at least 823 times, with resulting increases in toxic metals leachate. (FEIS, p. A- 534 citation to Day, Geochemical Uncertainty Analysis, October 10, 2008, Exhibit 11).[14] At best, lowering the water level in the East Pit is an improbable mitigation strategy; at worst, it is an additional untenable threat to water quality. (pg. 34)

PolyMet NorthMet tailings seepage would be collected from the toe of the tailings heaps and would contain sulfates and heavy metals from copper-nickel processing slurry, effluent from the mine site treatment plant, and LTVSMC tailings. (FEIS ref. NorthMet 2015j, FEIS Figure 3.2-12). PolyMet's modeling of seepage at the tailings toe is likely to understate actual tailings chemistry. Since leaching depends on surface area, data from MinnAMAX copper-nickel *tailings* would provide more comparable field experience than data from waste rock piles used in FEIS modeling. (FEIS, 5-62). Such data was not used. Leachate from MinnAMAX copper-nickel tailings contained maximum levels of cobalt more than 30 times the tailings seepage concentration predicted for the NorthMet project, levels of nickel more than 21 times the predicted P90 NorthMet concentrations, and sulfate concentrations more than 11 times higher than predicted NorthMet concentrations. (Johnson, 2015). (pg. 39)

The February 2007 PolyMet RS33/RS65 Hydrometallurgical Residue Characterization (available as WaterLegacy SDEIS Comment Exhibit 27, although not included among FEIS references) disclosed that hydrometallurgical leachate residue would have sulfate levels of 7,347 mg/L. Although we have found no document in the EIS record that provides contaminant levels for WWTP sludge, before reject concentrate is dewatered it will contain levels of arsenic and metals as much three orders of magnitude above limits and standards. At the P90 level, reject concentrate would contain: 1,150 µg/L of arsenic (2 µg/L criterion for drinking water); 16,600 µg/L of manganese (100 µg/L HRL for drinking water); 847 of cobalt (5 µg/L surface water limit); 11,600 µg/L of copper (9.3 µg/L limit in water with 100 mg/L hardness); 1,290 µg/L of lead (3.2 µg/L limit in water with 100 mg/L hardness); 8,230 mg/L of sulfate (10 mg/L limit in wild rice waters). (Water Modeling Data Package – Mine Site, PolyMet 2015m, autop. 452). (pg. 73)

This is not an academic question. As discussed in Section I on mercury, the FEIS claims the PolyMet NorthMet project would reduce CEC modeled sulfate loads to the Embarrass River, at least under the FEIS' assumption of nearly perfect seepage collection. But, if the NorthMet project's sulfide tailings seepage were compared with a "no action" baseline, including attenuation and remediation under the consent decree, this evaluation could show the NorthMet action increases rather than decreases sulfate and other pollutants. The FEIS doesn't even allow an answer to the most basic question – Would sulfate pollution be better or worse if the PolyMet NorthMet project were built? On water quality issues, the FEIS does not allow a fair comparison of environmental outcomes between the proposed action and the no build alternative. (pg. 83)

The treatment targets for the mine site wastewater treatment plant from year 1 to at least year 52 would not permit discharge of treated water to surface water. Based on current baseline hardness in the proposed West Pit Outlet Creek of less than 50 mg/L (FEIS, 4-91, Table 4.2.2- 15), the WWTF target for lead (10 µg/L) would be more than 7 times the water quality standard; the WWTF target for nickel (113 µg/) would be nearly 4 times the water quality standard, and the WWTF target for sulfate would be 250 mg/L, 25 times the standard applicable in wild rice Waters (FEIS, 5-148, Table 5.2.2-29). The predicted mercury concentration in WWTF effluent would be 5.8 ng/L, nearly five times the Great Lakes Initiative water quality standard of 1.3ng/L. (See PolyMet RS66, Mercury Mass Balance Attach. A, WaterLegacy SDEIS Comments Exhibit 4). This low-quality WWTF effluent could not be used to protect wetlands from water draw-down or to mitigate seepage impacts. (pg. 87)

Conductivity

Conductivity data on Barr 2014b Large Figure 2 (Exhibit 3) illustrate the difference between Duluth Complex rock and Virginia Formation rock in the vicinity of the P-2 test. Hydraulic conductivity in Duluth Complex rock was measured between 1.3E-06 and 3.5E-06 centimeters per second and that of nearby Virginia Formation rock between 1.7E-05 to 2.5E-04 centimeters per second; hydraulic conductivity was *up to 100 times greater* in proximate Virginia Formation rock than the Duluth Complex rock. (pg. 24)

Although new illustrations showing the direction and location of fractures and bedrock mine site geology were provided in a Barr report (Barr 2014b, Figures 1 and 2, Exhibit 3), no such depiction of fractures appears anywhere in the 3,576-page FEIS. The FEIS still minimizes the potential impacts of fractures and focuses its discussion on the primary conductivity of Duluth Complex rock. (FEIS, 4-51 to 4-52) The FEIS agrees that secondary porosity affects groundwater flow (FEIS, 4-48), but provides no new testing or modeling of secondary porosity features or assessment of the impacts of these secondary channels as conduits for mine pollution. (pg. 26)

As a result of PolyMet's new MODFLOW calibration, several bulk horizontal and vertical conductivity values changed between the SDEIS and the FEIS. Mean horizontal conductivity of wetland deposits *increased to 400 percent* of that calculated in the SDEIS (from 5.6 feet per day to 23.7 ft/day), as did both mean horizontal and mean vertical conductivity in lower Virginia Formation bedrock (from 0.019 ft/day to 0.079 ft/day for horizontal conductivity and from 0.0019 ft/day to 0.0079 ft/day for vertical conductivity). (Comparison is based on SDEIS, 5-27, Table 5.2.2-7 and FEIS, 5-29 Table 5.2.2-7). (pg. 26)

New information on faults and hydraulic conductivity also underscores the need to effectively model impacts on water quality from the East and West mine pits. New mapping shows that inferred faults transect the locations where the West Pit and East Pit would be located. (Barr 2014b, Large Figures 1 and 2, Exhibit 3). The 100 Mile Swamp wetlands and the northern side of the East Pit are located in Virginia Formation bedrock. (*Id.*) Faults and higher measured conductivity could increase seepage from mine pits as well as affecting wetlands. (pg. 28)

The volume of northward groundwater flow from the East Pit may be quite significant GLIFWC's preliminary modeling using the PolyMet MODFLOW model suggests that approximately 90% of the post-closure outflow from the NorthMet East Pit would migrate north due to the higher conductivity of the Virginia Formation and Biwabik Iron Formation and the lower elevations of the Peter Mitchell Pit at closure (1,300 feet) and over the long-term (1,500 feet) as compared to the Duluth Complex rock and Partridge River elevation (1,548 feet) on the south of the mine site. At closure, when the

Peter Mitchell Pit is 1,300 feet deep, northward outflow is estimated at 300 gpm, stabilizing at 75 gpm in long-term closure. (GLIFWC letter to Co-Lead Agencies Discharge from PolyMet East Pit at Closure, Oct. 20, 2015, Exhibit 9). (pg. 31)

Barr's memo highlighted the Fort McMurray tailings pond seepage containment system in Alberta Canada as an example of the successful use of slurry walls to isolate mine tailings seepage from downgradient water: Another example is the installation of a soil-bentonite cutoff wall around the perimeter of a mine tailings pond located in the province of Alberta, Canada. The cutoff wall is approximately 100-feet deep and 3 feet wide, and has a hydraulic conductivity of less than $1x10^{-7}$ cm/sec. The cutoff wall was used to isolate the tailings pond from downgradient surface water features including wetlands and the Athabasca River. (*Id.*, pp. 1-2). (pg. 44)

The PolyMet NorthMet FEIS completely failed to assess a pollutant that is characteristic of mining and is of particular concern for benthic macroinvertebrates and fish, the combination of ions and salts that is tested as specific conductivity.[29] WaterLegacy's comments on the SDEIS referenced EPA's research, *A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams,*[30] which set a benchmark conductivity level for Appalachian streams at 300 microSiemens per centimeter (µS/cm). Since the SDEIS, chemist Bruce Johnson and biologist Maureen Johnson, both former regulators for Minnesota and federal government agencies, have produced a report, *An Evaluation of a Field-Based Aquatic Life Benchmark for Specific Conductance* (hereinafter "Conductivity Evaluation"), attached as Exhibit 16. (pg. 60)

Dry Stacking

The FEIS does not consider dry stacking or other tailings alternatives. Co-Lead Agency responses to comments state, "A thickened (paste tailings) alternative was considered but eliminated in the DEIS." (FEIS, A-315). In fact, the DEIS screening process found that this thickened (not dry stack) tailings would address tailings basin mitigation issues, but "the operational cost of this measure would be high." (MDNR and USACE, 2009, 3-56, Table 3.2-2) Responses to comments also state that, after the DEIS, this alternative was "reconsidered" and determined not to offer significant environmental benefits, (FEIS, A-315) but no such analysis is provided in the SDEIS, the FEIS or any cited reference. (pg. 86)

The Co-Lead Agencies acknowledge that they received the *Independent Report* on Mount Polley after the SDEIS comment period ended and their technical analysis confirmed that "use of dry stacking technology would increase tailings basin stability." Further evaluation of this alternative was rejected, however, on the grounds that use of dry stacking requires a basin liner, which is not feasible on top of the existing LTVSMC tailings basin. Use of a different location and a lined dry stack facility was then rejected on the grounds, "A separate dry stack tailings basin would increase footprint effects of the project" and that "A separate dry stack tailings basin would not address LTVSMC tailings basin legacy issues." (FEIS, A-315). (pg. 86)